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Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

PART XIV STORAGE TESTS

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GUIDANCE FOR ENVIRONMENTAL TESTING

PART XIV STORAGE TESTS

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GUIDANCE FOR ENVIRONMENTAL TESTING

PART XIV STORAGE TESTS

0. FOREWORD

0.1 This Indian Standard (Part XIV) was adopted by the Indian Standards Institution on 24 July 1981, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard is largely based on Doc : 50B (Central Office) 222 'Draft — Guidance on the application of the tests of IEC Publication 68 to simulate the effects of storage' issued by the International Electrotechnical Commission (IEC).

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part XIV) provides guidance in specifying a proper storage test for electronic and electrical items.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definition shall apply.

2.1 Storage — The term 'storage' describes the keeping of electronic and electrical items for relatively long periods of time (ranging from some weeks to many years) in a non-operating mode, and:.

a) in the environmental conditions typical of industrial warehouses, retail stores, etc, or

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*Rules for rounding off numerical values (*revised*).

b) in reserve or emergency equipment or plant, for example, fire alarms, auxiliary motors, stand-by generators, etc; in this case, the item may be subjected to particularly severe environmental stresses due to the operation of the surrounding, plant, or

c) in installations which take a long time to complete, where the initial environment may be much more severe than the operational environment, for example, large telephone switching offices, large computer installations, power stations, etc.

3. DEFINITION AND OBJECT OF STORAGE TEST

3.1 A 'storage test' is intended to simulate the effects of one or more environmental stresses acting on items during their normal storage life, to establish whether:

a) storage prevents the use of the item in its intended application, for example, the solderability characteristics of component leads or printed circuit boards are worsened, the drift of electrical parameters is excessive, open-circuits or short-circuits; or

b) significant performance and/or reliability degradation occurs for items operated after storage; or

c) for emergency equipment, the ability of items to function correctly and reliably is not impaired after prolonged non-operation.

NOTE — For the reliability determination of relatively new items or those stored for long periods, and for the determination of functioning reliability after storage, reference should be made to the standards prepared by Reliability of Electronic and Electrical Components and Equipment Sectional Committee, LTDC 3.

4. EXAMPLES OF DEGRADATION MECHANISMS AND OF FAILURE TYPES UNDER STORAGE CONDITIONS

4.0 The following are typical examples of failure mechanisms and failure types occurring as a result of storage.

4.1 Component leads and printed circuit board solderability may be degraded due to oxidation or diffusion processes between base material and overplating. These processes are accelerated by heat, resulting in the formation of surfaces with greatly reduced solderability. Humid corrosion phenomena, perhaps accelerated by polluting substances in the atmosphere, may also be active.

4.2 Other examples of failure mechanisms due to humidity changes are:

4.2.1 Prolonged action of very low humidity, even at relatively low temperatures, may produce a considerable drying of plastics; electrical and mechanical properties of these materials may be degraded with consequent damage or failure during operation after storage.

4.2.2 A high humidity during storage may be more dangerous than it will be during operation, due to the absence of any self-heating effect. Prolonged storage at relative humidity levels higher than 80 percent at normal temperatures may adversely influence characteristics and reliability of the stored items.

4.2.3 The internal humidity of imperfectly sealed containers may progressively increase when stored under conditions of high relative humidity with high repetitive peak values of temperature, or cycling temperature even at moderately high relative humidity. Consequently, after a long storage time, condensation may occur inside the container due to a sudden limited temperature decrease.

4.2.4 Prolonged exposure in a high temperature environment may cause the drying of electrolytic capacitors and of batteries; loss of rigidity in thermoplastics; softening and creeping of protective compounds and of impregnating waxes. Generally, the ageing of materials is accelerated under these conditions.

4.2.5 Prolonged exposure to a cold environment may produce brittleness, cracking and breaking not only of rubber and plastics but also of metallic parts. Some seals may be degraded by shrinking or cracking.

4.2.6 Items stored under conditions of high relative humidity and temperature may be affected by mould growth, especially if organic materials are present. These conditions also accelerate the effects of chemical action, such as salt fog and industrial gases.

4.3 Blocking (seizing) of mechanical parts due to high temperature oxidation or to humid corrosion may occur.

4.4 The functional parameters of items may drift beyond specified limits. Open-circuits or short-circuits may occur.

5. CHOICE OF THE APPLICABLE TEST

5.0 It is obviously not possible to define a single storage test, as different parameters produce different stresses which may result in different types of deterioration or modes of failure.

5.0.1 The standard tests described in IS : 9000* may be conveniently used for the simulation of specific storage conditions. Usually storage tests are based upon cold test [IS : 9000 (Part II)-1977†], dry heat test

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*Basic environmental testing procedures for electronic and electrical items.

†Basic environmental testing procedures for electronic and electrical items: Part II Cold test.

[IS : 9000 (Part III)-1977*], damp heat (steady state) test [IS : 9000 (Part IV)-1979†] and damp heat (cyclic) test [IS : 9000 (Part V)-1981‡]. The test duration is generally long, possibly up to several months [the maximum period for damp heat (steady state) test is given as 2 months]. Other tests may be more significant for some cases (for example, salt mist, industrial atmosphere) and they should be considered during the preparation of a detailed storage specification.

5.0.2 It is recognized that standard tests are not intended to simulate actual conditions and it may be necessary to perform special tests in some circumstances. However, technical and economic considerations suggest that standard tests should be used wherever possible.

5.0.3 In the choice of the applicable test, the following should be taken into consideration:

a) The required object (*see* **3**);

b) The degradation mechanism and failure modes to be expected; these may be known from previous experience or from an analysis of the characteristics of the item and of the storage conditions, related to the interactions between environment and materials (*see* **4**);

c) The significant environmental stresses involved and whether they can be considered as acting individually, in combination or in sequence; and

d) The possibility of accelerating the degradation mechanisms, without substantially altering the failure modes or introducing new ones.

5.1 Reference should be made to the Guidance Standards (IS : 9001§) applicable to the test methods of IS : 9000‖. Some considerations are given here regarding special criteria to be followed in the choice of test severities, taking account of the objects of a storage test.

5.2 A test acceleration, useful in order to reduce the test duration, cannot always be obtained with a stress increase because important changes of the degradation mechanisms may arise, giving results which have no practical usefulness. Such a consideration applies, for example, to:

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*Basic environmental testing procedures for electronic and electrical items: Part III Dry heat test.

†Basic environmental testing procedures for electronic and electrical items: Part IV Damp heat (steady state).

‡Basic environmental testing procedures for electronic and electrical items: Part V Damp heat (cyclic) test.

§Guidance for environmental testing.

‖Basic environmental testing procedures for electronic and electrical items.

a) humid corrosion phenomena, with or without the action of atmospheric pollutants: increasing the relative humidity results in corrosion items which morphologically are totally different from those formed in natural conditions;

b) consequences of water vapour absorption by insulators, especially those related to the irreversible effects due to structural changes: humidity conditions less stringent than those specified in damp heat (steady state) test of IS : 9000 (Part IV -1979*, with lower temperatures and/or lower relative humidity may be appropriate, particularly when analyzing the effects on poorly protected items; and

c) slow deformation phenomena in some materials, so important for the parameter drift in electronic components: under natural conditions, such phenomena are often very different from those produced by rapid changes of temperature over an extended range.

5.3 In some cases the storage test may last a long time. The usefulness of the test is then due not to the reduction in time needed to obtain results, but to the fact that the phenomena occur under controlled and reproducible conditions.

Generally, for these tests with limited stress acting for a long time, greater changes of test conditions may be tolerated than for highly accelerated tests. Test equipment control and regulation is therefore simplified.

5.4 In other cases the test may be accelerated by an increase of the stress without substantially changing the deterioration mechanisms, for example:

a) a test temperature increase may accelerate the drying, for example, of electrolytic capacitors and of batteries and in general all the ageing processes of materials exposed to dry heat; and

b) brittleness, cracking and breaking of rubber, plastics and also some metallic parts, caused by low temperatures, may be accelerated by exposure to temperatures suitably lower than those of the actual storage conditions.

6. TEST PROCEDURE DETAILS

6.1 Storage tests as such do not require more attention than tests applied for other purposes (determination of characteristics, qualification, etc).

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*Basic environmental testing procedures for electronic and electrical items: Part IV Damp heat (steady state).

The normal precautions taken when carrying out tests, especially those related to the control of test equipment and associated instrumentation, are applicable to storage tests. Special care should be taken in the measurement of functional parameters particularly during and after very long duration tests. Recovery conditions following the test will often be important. For instance, dehydrated materials may start absorbing moisture, or materials which have absorbed or adsorbed moisture may start drying out.

6.2 In such cases the recovery conditions should be clearly defined and closely controlled, reference being made to the tests of IS : 9000*.

NOTE — Controlled recovery conditions are defined in **3.4.3** of IS : 9000 (Part I)-1977†.

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*Basic environmental testing procedures for electronic and electrical items.

†Basic environmental testing procedures for electronic and electrical items: Part I General.